# Chapter 8A: Achieving Long-Term Water Quality Goals

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## SUMMARY

The South Florida Water Management District (District), the Florida Department of Environmental Protection (FDEP), and other parties are aggressively pursuing interim and long-term Everglades water quality goals. Interim measures to reduce phosphorus levels include Everglades Agricultural Area (EAA) landowner Best Management Practices (BMPs) and construction and operation of stormwater treatment areas (STAs). These phosphorus control programs have proven very effective at reducing the amount of phosphorus entering the Everglades. As of this date, the EAA BMPs and downstream STAs have removed more than 1,400 tons of phosphorus that would otherwise have entered the Everglades. The EAA BMPs have exceeded their 25 percent load reduction target by yielding a more than 50 percent reduction. Average outflow concentrations from the STAs have been less than 35 parts per billion, well below their 50-ppb target. The long-term water quality goal established by the Everglades Forever Act (EFA) pertains to water delivered to the Everglades Protection Area (EPA) to achieve state water quality standards by December 31, 2006. Investigations of ways to improve STA performance and explore new technologies, aided by research in excess of $35 million to date, has resulted in significant advances toward achieving this long-term goal. This chapter describes the integration of research, planning, construction, and other activities designed to achieve this long-term water quality goal and identifies the key remaining challenges.

## INTRODUCTION

The Everglades Forever Act establishes a long-term water quality goal for water delivered to the EPA to achieve state water quality standards by December 31, 2006. By December 31, 2003 the EFA requires the South Florida Water Management (SFWMD or District) to submit to the FDEP a permit modification to incorporate proposed changes to the Everglades Construction Project (ECP), as well as permits issued for the other structures that discharge into, through, or from the EPA. If, by December 31, 2003, discharges to the EPA are in compliance with state water quality standards, including the phosphorus criterion, the permit application shall include a plan for maintaining compliance in the EPA with state water quality standards. If the ECP or other discharges to the EPA are not in compliance with state water quality standards by December 31, 2003, the permit application shall include:

1. A plan for achieving compliance with state water quality standards in the Everglades Protection Area
2. Proposed cost estimates for the plan referred to in (1), above

3. Proposed funding mechanisms for the plan referred to in (1), above
4. Proposed schedules for implementation of the plan referred to in (1), above

The EFA intended "to provide a sufficient period of time for construction, testing, and research so that the benefits of the ECP will be determined and maximized prior to requiring additional measures." (373.4592(1)(g), F.S.). At the present time, many scientific, engineering, regulatory, and other uncertainties remain that will significantly influence the final plan. Other sections of this *2003 Everglades Consolidated Report* (2003 ECR) describe the numerous research, regulatory, and construction activities, particularly Chapters 3, 4, and 8B on the Everglades Stormwater Program (ESP).

# WATER QUALITY IMPROVEMENT STRATEGIES

The District is currently developing water quality improvement strategies to determine the optimal combination of source-control, basin-level and regional solutions to achieve the long-term water quality goal. Four primary components to the water quality improvement strategies are anticipated:

1. Improvement of source controls, including Best Management Practices (BMPs)
2. Optimization of Stormwater Treatment Areas (STAs)
3. Testing of Advanced Treatment Technologies (ATT )
4. Synchronization with CERP Projects

The District is conducting basin-specific feasibility studies that will integrate information from research, regulation and planning to provide information necessary to allow policy makers to determine the optimal combination of source controls and basin-scale treatment to meet the final water quality objectives for the Everglades Protection Area. Of the 15 basins that discharge into the EPA, the basin-specific feasibility studies will identify and evaluate alternative solutions for seven basins covered by the Everglades Construction Project (ECP) and six basins covered by the Everglades Stormwater Program (ESP). The remaining two ESP basins (the C-111 basin and the Boynton Farms basin) will be addressed through other District and federal programs. A summary of the basins covered in the basin-specific feasibility studies is presented in **Table 8A-1**.

**Table 8A-1.** Everglades Protection Area tributary basins included in basin-specific feasibility studies

| Basin | Canal | STA | Receiving Water |
|---|---|---|---|
| S-5A (EAA) | West Palm Beach Canal | STA-1W, STA-1E, STA-2 | A.R.M. Loxahatchee National Wildlife Refuge (WCA-1) |
| S-6 (EAA) | Hillsboro Canal | STA-2 | WCA-2A |
| S-7 (EAA) | North New River Canal | STA-3/4 | WCA-3A |
| S-8 (EAA) | Miami Canal | STA-3/4, STA-6 | WCA-3A |
| C-51 West & L-8 Basin | C-51 West | STA-1E, STA-1W | A.R.M Loxahatchee National Wildlife Refuge (WCA-1) |
| C-139 (including Annex) | L-3 Canal | STA-5, STA-6 | WCA-3A |
| ACME Basin B | N/A | N/A | WCA-1 |
| North Springs Improvement District | N/A | N/A | WCA-2A |
| North New River Canal (G-123) | North New River Canal | N/A | WCA-3A |
| C-11 West | C-11 West | N/A | WCA-3A |
| Feeder Canal | L-28 Interceptor Canal | N/A | WCA-3A |
| L-28 | L-28 | N/A | WCA-3A |

The basin-specific feasibility studies are being conducted according to the following steps:

1. Develop baseline flow and phosphorus data sets
2. Develop a methodology to evaluate alternative water quality measures based on the factors established in the 1994 Everglades Forever Act, and other appropriate considerations
3. Develop basin-specific alternative combinations of water quality solutions (source control, STA optimization, and Advanced Treatment Technologies)
4. Evaluate alternative solutions developed in step 3 using the Evaluation Methodology developed in step 2

In step 1, the District developed baseline flow and phosphorus data sets for 13 basins covered by the basin-specific feasibility studies (Goforth and Piccone, 2001). The 31-year baseline flow and phosphorus data sets developed for each basin are summarized in **Table 8A-2**. In general, the baseline data sets combine simulated flow values from the South Florida Water Management Model (SFWMM) for the period 1965 through 1995, with historic phosphorus concentrations developed from water years 1990 through 1999.

**Table 8A-2.** Summary of simulated baseline flows and phosphorus (1965-1995)

| Basin / STA | Mean Annual STA Inflow (acre-feet) | STA Inflow Phosphorus (parts per billion) | Mean Annual Phosphorus Load (kg) | Mean Annual Discharge to EPA (acre-feet) | Discharge Phosphorus (parts per billion) | Mean Annual Phosphorus Load (kg) |
|---|---|---|---|---|---|---|
| C-51 West / STA-1 East | 133,331 | 176 | 28,950 | 148,400 | 38 | 6,957 |
| S-5A / STA-1 West | 160,335 | 139 | 27,399 | 188,100 | 24 | 5,569 |
| S-6 / STA-2 | 233,473 | 100 | 28,831 | 223,200 | 33 | 9,086 |
| S-7, S-8 / STA-3/4 | 660,889 | 88 | 72,019 | 623,700 | 36 | 27,698 |
| C-139 / STA-5 | *132,113** | *178** | *29,039** | *125,900* | 32 | 4,970 |
| EAA, C-139 Annex / STA-6 (Sections 1 and 2) | *37,887** | *85** | *3,978** | *35,300* | 28 | 1,219 |
| Acme Basin B | N/A | N/A | N/A | 31,499 | 94 | 3,660 |
| North Springs Improvement District | N/A | N/A | N/A | 6,168 | 39 | 293 |
| N. New River Canal Basin | N/A | N/A | N/A | 1,781 | 18 | 40 |
| C-11 West Basin | N/A | N/A | N/A | 194,167 | 17 | 4,063 |
| L-28 Basin | N/A | N/A | N/A | 83,806 | 39 | 3,982 |
| Feeder Canal Basin | N/A | N/A | N/A | 77,179 | 156 | 14,854 |

Reference: Goforth and Piccone, 2001

Notes:

1. Inflow volumes, concentrations and loads for STA-5 and STA-6 were revised since the 2001 Baseline Data Report. The results of a new SFWMM simulation (BASERR2R, Dec. 2001) are shown in italics
2. All STA baseline discharge volumes, concentrations, and loads were revised since the 2001 Baseline Data Report. The values shown are the draft results of DMSTA simulations performed by the consultant

In step 2, the District, in concert with stakeholders and consultant teams, developed an evaluation methodology for evaluating alternative water quality solutions. The evaluation methodology was developed to assist in achieving the December 2003 (integrated water quality plans and permit applications) and December 2006 (compliance with water quality standards) mandates of the Everglades Forever Act. The evaluation methodology, which was independently peer reviewed and refined over a period of several months, contains technical, environmental and economic criteria that are summarized in **Table 8A-3**. The evaluation methodology can be viewed online at: http://www.sfwmd.gov/org/erd/bsfboard/bsfsboard.htm.

**Table 8A-3.** Summary of evaluation factors

| Evaluation Factor | Unit |
|---|---|
| **Technical Performance Criteria** | |
| Level of phosphorus load reduction | % |
| Long-term flow-weighted mean phosphorus concentration achieved | ppb |
| Long-term geometric mean phosphorus concentration achieved | ppb |
| Implementation schedule | years |
| Operational flexibility, including adaptive Management | -3 worst<br>+3 best |
| Resiliency to extreme conditions | -4 worst<br>+4 best |
| Assessment of full-scale construction and Operation | -3 worst<br>+3 best |
| Management of side streams | -3 worst<br>+3 best |
| **Environmental Criteria** | |
| Level of improvement in non-phosphorus parameters | -19 worst<br>+19 best |
| **Economic Criteria** | |
| 50-yr Present Worth Cost | $ |
| Cost-effectiveness | $/kg |

In step 3, again in concert with stakeholders and consultant teams, the District developed alternative combinations of point source control, basin-level, and regional water quality treatment solutions for the 13 Everglades Protection Area tributary basins covered by the basin-specific feasibility studies. In preparing these alternative solutions, the District used the baseline flow and phosphorus data sets and the results from BMP research, STA optimization research, Advanced

Treatment Technologies research and other ongoing research activities. The majority of Everglades tributary basins covered in the basin-specific feasibility studies also contain components of the Comprehensive Everglades Restoration Plan (CERP). These components were taken into account when developing the alternatives because they can significantly influence baseline flows and water quality characteristics and because opportunities exist for cost savings by integrating the long-term water quality solutions with the CERP components. Documents describing the alternatives can also be found online at: http://www.sfwmd.gov/org/erd/bsfboard/bsfsboard.htm.

To complete step 4, the District procured the services of two consulting firms to evaluate the alternatives described in step 3, above. The consulting firm of Burns and McDonnell is evaluating the ECP basin alternatives, while the ESP basin alternatives are being evaluated by the consulting firm of Brown and Caldwell. The consulting firms are using the evaluation methodology developed in step 2 to evaluate the alternatives shown in **Table 8A-4** (ECP basins) and **Table 8A-5** (ESP basins).

**Table 8A-4.** Summary of ECP basin alternatives

| Basin/STA | Alt. | Source Controls | CERP Project | Regional Treatment | Regional Treatment Target Completion |
|---|---|---|---|---|---|
| **STA-1E** | Baseline | 0% C-51W runoff and ~50% S-5A portion | N/A | STA-1E (existing) | 2006 |
| | 1 | 0-25% for C-51W & 25-75% for S-5A | N/A | Optimize STA-1E by 2006 | 2006 |
| | | | | | |
| **STA-1W** | Baseline | ~50% | N/A | STA-1W (existing) | 2006 |
| | 1 | 25-75% | N/A | Optimize STA-1W by 2006 | 2006 |
| | | | | | |
| **Combined STA-1E & STA-1W** | 2 | 0-25% for C-51W & 25-75% for S-5A | N/A | If needed, expand STA-1E and STA-1W by 2006 | 2006 |
| | 3 | 0-25% for C-51W & 25-75% for S-5A | N/A | If needed, expand STA-1E and STA-1W to treat Acme Basin B by 2006 | 2006 |
| | 4 | 0-25% for C-51W & 25-75% for S-5A | 2011 | Optimize STA-1E and divert Acme Basin B runoff to STA-1E by 2006, then if needed, divert/Treat Acme Basin B in Rock Pits by 2011 | 2006 |
| | | | | | |
| **STA-2** | Baseline | ~50% | N/A | STA-2 (existing) | 2006 |
| | 1 | 25-75% | N/A | Optimize STA-2 by 2006 | 2006 |
| | 2 | 25-75% | N/A | If needed, construct chemical treatment facility within footprint of STA-2 by 2006 | 2006 |
| | | | | | |
| **STA-3/4** | Baseline | ~50% | N/A | STA-3/4 (existing) | 2006 |
| | 1 | 25-75% | 2014 | Optimize STA-3/4 by 2014 | 2014 |
| | 2 | 25-75% | 2014 | Optimize STA-3/4 by 2006 | 2006 |
| | 3 | 25-75% | 2014 | If needed, expand STA-3/4 by 2006 using SAV | 2006 |
| | 4 | 25-75% | 2014 | If needed, expand STA-3/4 by 2006 using PSTA | 2006 |
| | | | | | |
| STA-5 and STA-6 | Baseline | 50% for EAA; 0% for C-139 | N/A | Existing STA-5 and STA-6, Sections 1 and 2 | 2006 |
| | 1 | 25-75% for EAA & 25% for C-139 | 2014 | Optimize, if needed, STA-5 and STA-6, Sections 1 and 2, by 2014 | 2014 |
| | 2 | 25-75% for EAA & 25% for C-139 | 2014 | Optimize treatment in STA-5 and STA-6 by 2006 | 2006 |
| | 3 | 25-75% for EAA & 25% for C-139 | 2014 | Expand STA-5 to the west, optimize STA-5 and STA-6 Section 1, and size STA-6 Section 2 as needed | 2014 |
| | 4 | 25-75% for EAA & 25% for C-139 | 2014 | STA-5 and STA-6, Sections 1 and 2 | 2014 |

**Table 8A-5.** Summary of ESP basin alternatives

| Basin/STA | Alt. | Source Controls | CERP Project | Regional Treatment | Regional Treatment Target Completion |
|---|---|---|---|---|---|
| | | | | | |
| **Acme Basin B** | 1 | 25% by 12/31/06; use 0% and 50% in sensitivity analysis | 2013 | None - diversion away from Everglades | 2013 |
| | 2 | 25% by 12/31/06; use 0% and 50% in sensitivity analysis | N/A | Construct chemical treatment facility | 2006 |
| | 3 | 25% by 12/31/06; use 0% and 50% in sensitivity analysis | N/A | Construct STA on 375 acres owned by District | 2006 |
| | 4 | 25% by 12/31/06; use 0% and 50% in sensitivity analysis | N/A | Construct STA on 375 acres + additional land if needed | 2006 |
| | Base Condition | Assumes 25% load reduction due to source controls | N/A | None | N/A |
| | | | | | |
| **C-11W** | 1 | 0% by 12/31/06; use 25% in sensitivity analysis | 2036 | Construct chemical treatment facility | 2005 |
| | 2 | 0% by 12/31/06; use 25% in sensitivity analysis | 2036 | Construct STA | 2005 |
| | Base Condition | 0% by 12/31/06; use 25% in sensitivity analysis | 2036 | None - diversion of most of the runoff away from Everglades | N/A |
| | | | | | |
| **NSID** | 1 | N/A | 2007 | None - diversion away from Everglades | 2006 |
| | 2 | N/A | N/A | None - diversion away from Everglades | 2006 |
| | Base Condition | 0% by 12/31/06; use 25% in sensitivity analysis | 2007 | None - diversion away from Everglades | N/A |
| | | | | | |
| **NNRC** | 1 | N/A | 2018 | Construct chemical treatment facility and operate through 2018 then divert away from Everglades | 2006 |
| | 2 | N/A | 2018 | None- discontinue use of G-123 by 2006 | N/A |
| | Base Condition | 0% by 12/31/06; use 25% in sensitivity analysis | 2018 | None - continue G-123 discharges until 2018, then divert away from Everglades | N/A |
| | | | | | |
| **L-28** | 1 | 0% by 12/31/06; use 25% in sensitivity analysis | 2015 | Construct STA | 2006 |
| | Base Condition | 0% by 12/31/06; use 25% in sensitivity analysis | 2015 | None | N/A |
| | | | | | |
| **Feeder Canal** | 1 | 50, 75 and 100 ppb | 2015 | Construct STA | 2006 |
| | Base Condition | 50, 75 and 100 ppb | 2015 | None | N/A |

The consultants are using the Dynamic Model for Stormwater Treatment Area (DMSTA) to evaluate the phosphorus-removal performance of the alternatives that use biological systems. The evaluations will also include sensitivity analyses to deal with technical and other uncertainties.

The evaluation of alternatives is scheduled for completion in November 2002. This evaluation of alternatives is a fact-gathering activity and, by itself, will not determine or recommend an optimal combination of water quality treatment solutions. However, the results of the evaluation will give the legislature, the District governing board and other stakeholders the critical technical information necessary for making the necessary policy decisions to determine the optimal combination of water quality treatment solutions. It is anticipated that once the policy

makers determine the optimal solution and sufficient funds are appropriated, individual water quality improvement solutions will be finalized for each basin, and subsequent design and construction will proceed.

The subsequent conceptual engineering designs are scheduled to be completed by November 2003, in time to be included in the permit applications to be submitted to the FDEP by December 31, 2003. However, successful development and implementation of the water quality improvement strategies will require integration of numerous research, planning, regulatory and construction activities, as introduced in Chapter 1. Both the District and the FDEP are committed to achieving the long-term water quality goals. Some of the more significant challenges include regulatory issues, uncertainties in source control and regional treatment technologies, synchronization with CERP projects, and lack of funding.

# CHALLENGES TO ACHIEVING LONG-TERM WATER QUALITY GOALS

## REGULATORY ISSUES

Two relevant regulatory issues are being addressed by the State of Florida's Environmental Regulation Commission (ERC):

1. Establishing numeric criterion for phosphorus in the Everglades
2. Establishing the measurement methodology, i.e., the locations and frequency of monitoring for compliance with the phosphorus standard

The EFA requires the FDEP to initiate phosphorus (P) criterion rulemaking by December 2001; efforts on rule development were begun during summer 2001. The EFA establishes a default P criterion of 10 parts per billion (ppb) if rulemaking is not completed by December 31, 2003. Concurrent with P criterion rulemaking, the method for determining compliance with these criteria will be finalized in accordance with the framework described in the EFA (section 373.4592(4)(e)3, F.S.):

> "Compliance with the phosphorus criterion shall be based upon a long-term geometric mean of concentration levels to be measured at sampling stations recognized from the research to be reasonably representative of receiving waters in the Everglades Protection Area, and so located so as to assure that the Everglades Protection Area is not altered so as to cause an imbalance in natural populations of aquatic flora and fauna and to assure a net improvement in the areas already impacted."

Once the numeric criterion and measurement methodology are established, the FDEP will be able to establish discharge limits for waters entering the Everglades Protection Area. To establish these limits, the FDEP will consider the relationship between waters entering the Everglades and the resulting water quality in the Everglades. Details on the P criterion development are presented in Chapter 5.

In addition, the FDEP must complete rulemaking to revise water quality standards for parameters other than P for the Everglades Protection Area and the EAA canals, recognizing the existing beneficial uses of the EAA canals. Although the EFA does not set a specific deadline for

this rulemaking, it is assumed it will be completed by December 31, 2003. Other regulatory issues are discussed in Chapter 3.

## STA OPTIMIZATION AND ATT RESEARCH

Current research results have yet to identify full-scale Advanced Treatment Technologies (ATTs) that reliably and consistently produce P levels of 10 ppb at the point of discharge (referred to as "end-of-pipe"). Chapter 4 presents a summary of STA optimization and ATT research. While critical research is continuing on STA optimization and ATTs, the basin-specific feasibility studies will use a combination of best available information and sensitivity analyses to deal with these key uncertainties.

## SOURCE CONTROL MEASURES

It is anticipated that the long-term Everglades water quality solutions will contain a combination of source control and regional treatment technologies. While landowners within the EAA have implemented very effective source control BMPs, comparatively little is known about the technical efficacy and economics of controlling P loads from urban and other rural basins. The basin feasibility studies will use sensitivity analyses to predict the influence of source controls on overall basin phosphorus performance.

## SYNCHRONIZATION WITH CERP PROJECTS

The majority of Everglades tributary basins contain proposed CERP projects to be completed between 2002 and 2038 (based on July 2001 CERP schedules). There is significant potential for taxpayer and private cost savings by synchronizing and possibly integrating the water quality improvement strategies with the CERP projects. This may require working with the legislature and other parties to synchronize timeframes and funding mechanisms.

## FUNDING ISSUES

Funds need to be appropriated for implementation (land acquisition, design, construction and operation) of long-term water quality solutions. The Everglades Forever Act allocated several state sources for funding the implementation of the interim solution (e.g., the ECP). However, funding for implementation of long-term solutions has not been appropriated. The preliminary cost estimates will be developed as part of the basin-specific studies. Funding schedules will be developed as part of the subsequent design process.

## STRATEGY FOR LONG-TERM SOLUTIONS

The EFA establishes an orderly process of research and rulemaking to develop a sound foundation for making decisions regarding long-term water quality solutions. This process, described above, remains the current strategy for achieving long-term compliance with all water quality goals. If the interim water quality program alone cannot achieve the long-term goals, this orderly approach should enable sound, science-based decisions to be made on additional water quality treatment options.